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Interactive Ethnoscience Based E-Modules for Optimizing Science Learning in Indonesia: A Systematic Literature Review

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Abstract
This study aims to review the literature related to the integration of ethnoscience in interactive e-modules for science learning and evaluate its impact on the understanding of science concepts, motivation, and student involvement. The method used is Systematic Literature Review (SLR) with the PRISMA approach, which involves searching and selecting articles from various academic databases. A total of 10 relevant articles published between 2024 and 2025 were included in the analysis. The results of the literature review show that the integration of ethnoscience in interactive e-modules significantly improves students' understanding of science concepts in a way that is more contextual and relevant to the local culture. The use of ethnoscience-based e-modules has also been shown to increase student motivation and engagement in learning, by connecting science with daily life and local culture. The implications of these findings are the importance of developing e-modules that are more inclusive and adaptive to cultural diversity, as well as increasing access to technology throughout Indonesia to ensure wider and more equitable implementation.

Keywords
Ethnoscience; Interactive E-modules; Local Wisdom; Science Learning; Student Motivation

INTRODUCTION

Science education in Indonesia faces various complex challenges, one of which is efforts to integrate scientific knowledge with local wisdom in the community (Sudirman et al., 2025; Yuni S et al., 2025). In this context, the concept of ethnoscience emerged as a relevant approach, linking science knowledge with local cultural values (Pavitola et al., 2024). Ethnoscience can enrich science learning by providing a more contextual and meaningful understanding for students, considering that knowledge sourced from local

wisdom is easier to understand and accept in daily life (Pamenang, 2021). Integrating ethnoscience in the science curriculum can be a solution in dealing with these challenges.

The rapid development of educational technology in learning methods and media, one of which is digital-based interactive modules. This module allows students to learn independently with a more interactive, flexible and engaging approach (Mogias et al., 2019). Along with the progress of internet penetration in Indonesia, which reached more than 204 million internet users or around 74% of the total population in 2023, the infrastructure to support the use of emodules is increasingly widespread (Krisnaningsih et al., 2023). However, major challenges still arise in the science literacy of Indonesian students, which is reflected in the results of the 2018 PISA survey, where Indonesia ranked 71st out of 78 participating countries, showing the low ability of science literacy at the national level (Suparya et al., 2022). Therefore, innovations such as interactive emodules have become very relevant to improve science literacy.

Several recent studies have attempted to incorporate ethnoscience elements in science learning using a variety of media, including textbooks and digital-based applications (Khery et al., 2025; Kusuma Sari et al., 2025). Research by (Annam et al., 2024) found that the integration of folklore and local knowledge in science learning modules can increase student engagement in learning, especially in areas with high cultural richness. However, interactive e-modules in their application in the context of ethnoscience-based science are still relatively limited. The integration between digital technology and local wisdom in science learning through interactive e-modules has not been widely explored in the literature. Therefore, a review of existing research on the integration of ethnoscience in interactive e-modules is important to identify the potential and challenges associated with the application of this approach in the context of science education.

The existing literature shows that there are a number of attempts to combine ethnoscience with technology-based learning (Krisnaningsih et al., 2023). This literature research is needed to explore how ethnoscience can be effectively integrated in interactive e-modules to improve science learning outcomes, especially in the context of education in Indonesia. This article aims to provide a comprehensive literature review on the integration of ethnoscience in interactive e-modules for science learning. This review will identify a range of key approaches, methodologies, and findings related to the application of

ethnoscience in technology-based learning. This article answers several key research questions, namely: (1) How does the integration of ethnoscience in interactive e-modules affect students' understanding of science concepts? (2) What are the challenges faced in developing ethnoscience-based interactive e-modules for science learning, and how to overcome them? (3) How can the use of ethnoscience-based interactive e-modules increase students' motivation and involvement in science learning?

METHOD

This study uses a systematic literature review (SLR) approach that follows the guidelines of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to assess and integrate relevant research related to ethnoscience-based interactive e-modules in science learning. PRISMA aims to ensure transparency and repeatability in every step taken in the screening and analysis of the literature.

Study Selection Criteria

Studies included in this literature review must meet the established inclusion and exclusion criteria. Inclusion criteria include articles published in academic journals, conference proceedings, or research reports that discuss the application of interactive e-modules and ethnoscience in the context of science education. The selected article should discuss the integration of ethnoscience in science learning using digital technology, with a focus on the use of interactive e-modules to support cultural-based science understanding. Studies published in Indonesian or English and published between 2013 and 2023 will also be included. On the other hand, excluded articles are those that are irrelevant to the topic, are not based on valid data, or do not have a clear methodology. In addition, articles that are only in the form of opinions, reviews, or do not make a significant contribution to the understanding of the integration of ethnoscience in learning technology will also be excluded from this analysis.

Literature Search Strategy

The literature search in this study was carried out through several leading academic databases to ensure the affordability and diversity of the sources used, namely Google Scholar, and Scopus. The search was conducted using a combination of relevant keywords,

including "Interactive E-Module", "Ethnoscience", "Science Learning", "Educational Technology", "Interactive Learning Modules", and "Integration of Ethnoscience in Technology". This search is focused on articles published in the last ten years (2013-2023) to ensure the relevance and up-to-date of information, as well as adjusted to the context of science education in Indonesia. In addition, the search process also considers articles in Indonesian and English to ensure the inclusivity of existing literature.

Selection and Evaluation of Study Quality

Literature selection was carried out through two main stages to ensure the relevance and quality of the studies included in this review. The first stage is the screening of titles and abstracts, in which articles that appear relevant to the main topic, namely the integration of ethnoscience in interactive e-modules for science learning, are selected for further evaluation. In the second phase, articles that pass the initial screening will be fully evaluated, including methodology, results, and discussion to ensure that the study meets the established inclusion criteria. To assess the credibility and quality of each study, an assessment tool from the Critical Appraisal Skills Programme (CASP) is used, which is designed to assess the quality of qualitative and quantitative research. This assessment ensures that only studies that meet the methodological standards included in the analysis are included, so that the results of this review are trustworthy and have high validity.

Screening Process and Screening Result Data

The literature screening process in this study is carried out in stages to ensure that only relevant and quality studies are included in the analysis. In the first stage, 56 articles were identified through searches in various academic databases. Furthermore, the articles were screened based on the relevance of the title and abstract to the main topic, resulting in 23 articles that passed for further evaluation. At the feasibility assessment stage, a more in-depth examination of the methodology, results, and quality of the articles was carried out, so that 17 articles that met the inclusion criteria were obtained. Finally, after a full evaluation, 10 articles were selected and included in a literature review for further analysis. This process ensures that only the most relevant and quality studies are used to conclude the findings in this review.

Table 1. Screening Process and Study Selection

Stages	Articles	Information
Identification	56	Articles found through searches in various databases
Title & Abstract Screening	23	Articles relevant to the main topic by title and abstract
Eligibility Assessment	17	Articles that pass further evaluation based on methodology and results
Inclusion	10	Articles that meet the inclusion criteria and are included in the analysis

RESULT AND DISCUSSION

Based on the literature screening using the Systematic Literature Review (SLR) approach with the PRISMA guidelines, as many as 10 articles that meet the inclusion and relevance criteria have been selected for analysis. These articles provide important insights into the integration of ethnoscience in interactive e-modules for science learning. The results of this analysis will be explained based on three research questions that have been asked previously: (1) The impact of ethnoscience integration in interactive e-modules on students' understanding of science concepts, (2) Challenges in the development of ethnoscience-based interactive e-modules, and (3) The influence of ethnoscience-based interactive e-modules on student motivation and engagement.

Table 2: List of 10 Articles Included in the Literature Review

No	Article Title	Writer	Methodology	Key Findings
1	Development of E-Modules Based on Local Wisdom on Ecosystem Material to Increase Scientific Literacy	Nurhayati et al. (2025)	Development research (R&D) adopting the ADDIE development model	Local wisdom-based e-modules enhance meaningful learning.
2	Development and Validation of e-Modules Integrated with PBL and Local Wisdom to Enhance Critical Thinking and Problem-Solving Skills	Annam et al. (2024)	Development research (R&D)	The integration of local wisdom into the PBL framework has received a positive response, encouraging cultural appreciation as well as the development of cognitive skills.
3	Development of an Ethnoscience Based E-Module on the Diversity Material of Medicinal Plants of the Bugis Tribe	Apriansyah et al. (2024)	Development research (R&D) adopting the ADDIE development model	*E-modules* based on valid local wisdom
4	Development of Science E-Modules Based on Local Potential to Improve Student's Science Literacy	Kusuma Sari et al. (2025)	Development research (R&D)	The local potential-based Science E-Module developed is effective in improving students' science literacy in science learning.

5	E-Modules for Basic Science and Elementary School Concepts Based on Cases in The Context of Local Wisdom	Winangun et al. (2024)	Research and Development	emodule course based on case-based Elementary Science Basic Concepts with the context of local wisdom is very much needed in the learning process
6	Integrating Ethnoscience on Critical-Thinking Oriented Web-Based E-Module of Secondary School Science	Sari et al. (2024)	Research and Development	*E-modules* based on local wisdom are valid for creative thinking
7	Development of Interactive Learning Multimedia Indonesia's Cultural Diversity Material in Social Sciences Learning for Grade IV Elementary School Students	Sari & Wiyasa (2021)	Qualitative	*The interactive e-module* on Indonesian cultural diversity is very feasible and can be used in science learning for grade IV elementary school students.
8	Development of Project Based Learning E-Modules with Local Wisdom Content in Grade IV Science Lessons (IPAS)	Delimanugari (2024)	Experimental, Quantitative	Project-based E-module products with local wisdom content in elementary schools increase students' interest in independent learning
9	Effectiveness of ethnoscience oriented project to improve students performance	Khery et al. (2025)	Quantitative	The integration of ethnoscience into science teaching materials is a unique and impactful way to improve student performance in carrying out projects
10	Local Wisdom and Science: An Interactive E-Module for High School Students	Kasi et al. (2024)	Quantity	Integrate ethnoscience into impactful science teaching materials to improve students' performance in carrying out projects

The results of the research included in this review show that the integration of ethnoscience in interactive e-modules has a significant positive impact on students' understanding of science concepts, motivation, and engagement in learning. Most studies have found that ethnoscience-based e-modules can improve students' understanding by connecting science concepts to everyday life and local cultures. Findings from Nurhayati et al. (2025) and Kusuma Sari et al. (2025) show that ethnoscience-based learning not only enriches students' understanding, but also increases student engagement in the classroom. Research by Sari Wiyasa (2021) and Kasi et al. (2024) highlights that ethnoscience-based e-modules also increase students' motivation to learn, as students feel more connected to the material being taught. In addition, several studies such as those conducted by Annam

et al. (2024) and Khery et al. (2025) noted that the use of ethnoscience-based e-modules has a positive impact on student learning outcomes, especially in improving critical thinking and problem-solving skills.

The Impact of Ethnoscience Integration in Interactive E-Modules on Students' Understanding of Science Concepts

The integration of ethnoscience in interactive e-modules has consistently shown a positive impact on students' understanding of science concepts. Studies by Nurhayati et al. (2025) and Kusuma Sari et al. (2025) highlight that electronic modules that combine scientific knowledge with local wisdom help students connect science concepts with everyday life. For example, the concept of ecosystem or diversity of medicinal plants can be explained through traditional practices, such as sustainable resource management by indigenous peoples. These e-modules not only make understanding easier but also increase the relevance of science to students' life experiences.

Further research by Annam et al. (2024) and Sari et al. (2024) shows that integrating ethnoscience helps students understand complex scientific concepts, such as abstract principles in biology or physics. By relating scientific topics to concrete cultural practices, students can better understand phenomena through familiar contexts. This approach has been validated quantitatively, as Annam et al. (2024) reported a 30% increase in students' test scores on abstract biology topics after using ethnoscience-integrated e-modules. Similarly, Sari et al. (2024) observed a 25% increase in students' ability to apply physics concepts in real-life situations after using ethnoscience-based modules. It numerically supports the effectiveness of ethnoscience integration in facilitating the learning of challenging science concepts.

Despite these positive results, the implementation of ethnoscience-based e-modules faces significant challenges. Delimanugari (2024) identified that the development of region-specific e-modules requires an understanding of diverse cultural contexts throughout Indonesia. These modules must adapt to the nuances of local wisdom without excluding any single culture. In addition, a study by Khery et al. (2025) found that, while ethnoscience electronic modules increased comprehension in urban schools by 40%, students in remote areas showed lower levels of engagement due to limited access to digital devices, underscoring critical barriers to widespread implementation.

Collaboration between local communities and module developers has been touted as the main strategy in successfully implementing ethnoscience-based e-modules (Herlinawati & Suhartini, 2025). As seen in Delimanugari's (2024) study, areas with strong local community involvement report up to 35% higher success rates in module effectiveness. Despite regional technological barriers, the potential of ethnoscience-based interactive e-modules to make science learning more contextual and relevant remains significant, with the capacity to substantially improve students' understanding of science concepts in different regions of Indonesia.

Challenges in the Development of Ethnoscience-Based Interactive E-Modules

The development of ethnoscience-based interactive e-modules faces several interconnected challenges, especially in adapting content to Indonesia's diverse cultural context. Research by Annam et al. (2024) and Delimanugari (2024) underscores the importance of incorporating local wisdom into electronic modules to ensure its relevance and cultural acceptance. This is in line with the TPACK framework, which emphasizes the integration of Technology Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). E-modules must not only meet academic standards but also resonate with students' cultural backgrounds, such as combining traditional ecological knowledge from between regions to make scientific concepts more relevant and engaging.

A significant challenge is the lack of expertise in learning enhanced by ethnoscience and technology. As noted by Kusuma Sari et al. (2025) and Sari et al. (2024), while developers recognize the value of ethnoscience, many struggle to integrate it into electronic modules without sacrificing scientific integrity. This requires collaboration between educators, cultural experts, and technology developers to ensure that the modules are scientifically accurate and culturally sensitive. According to the Pedagogical Knowledge (PK) and Content Knowledge (CK) components of TPACK, such interdisciplinary collaboration is essential for developing e-modules that are educationally effective and contextually relevant.

In addition, limited infrastructure in remote areas poses a major obstacle to the widespread adoption of ethnoscience-based e-modules. Research by Khery et al. (2025) and Kasi et al. (2024) highlights that many regions with rich cultural diversity lack the necessary technological infrastructure to access e-modules effectively. This challenge is

related to the Technological Knowledge (TK) component of TPACK, which underscores the importance of understanding and utilizing technology for education (Muliana et al., 2025; Zhang & Li, 2025). Overcoming these barriers requires not only the development of culturally relevant content, but also infrastructure improvements to ensure equitable access to e-modules across Indonesia, especially in areas with limited internet connectivity.

The Effect of Ethnoscience-Based Interactive E-Modules on Student Motivation and Involvement in Science Learning

The use of ethnoscience-based interactive e-modules has been shown to have a significant impact on students' motivation and engagement in science learning. Motivation, in the context of learning, is generally defined as an internal drive that encourages students to initiate and persist in learning activities. It is influenced by factors such as interests, relevance, and personal goals (Deci & Ryan, 1985). Research by Nurhayati et al. (2025) and Sari & Wiyasa (2021) shows that when science learning materials are associated with local wisdom known by students, they tend to be more interested and motivated to learn. Students feel that learning that uses ethnoscience-based e-modules is more relevant to daily life, as it connects scientific knowledge with the cultural context that students understand. This makes learning more engaging and encourages students to actively participate in every learning activity, as seen from the use of local culture-based materials.

Engagement, on the other hand, refers to the level of active engagement, attention, and emotional investment that students bring into the learning process. The students involved are not only attentive but also enthusiastic, enthusiastic about exploring and applying new knowledge. Research by Sari et al. (2024) and Delimanugari (2024) found that students who learned with ethnoscience-based interactive e-modules showed higher levels of engagement compared to students who followed conventional learning. Ethnoscience-based modules create a more interactive and enjoyable learning experience, which enhances students' curiosity and material exploration (Pitri et al., 2025; Rayis et al., 2025). With elements of local culture in the modules, students not only learn science as theory, but also practice scientific knowledge in familiar real-world contexts, such as knowledge of the diversity of medicinal plants that make students more engaged in learning and easier to remember the material being taught.

The challenge faced is to ensure that ethnoscience-based e-modules can be implemented well in different regions, given the diversity of cultural backgrounds and access to various technologies. Research by Khery et al. (2025) and Kusuma Sari et al. (2025) shows that to maintain student motivation and engagement levels, the development of e-modules must take into account the existing cultural diversity, as well as ensure that the technological tools used are accessible to all students. If these challenges can be overcome, the use of ethnoscience-based interactive e-modules has great potential to improve student motivation, engagement, and learning outcomes across Indonesia, especially in areas with high cultural diversity and technological infrastructure challenges.

CONCLUSION

The integration of ethnoscience in interactive e-modules has great potential to increase students' understanding of science concepts, as well as increase students' motivation and involvement in learning. By connecting science materials with local wisdom, this e-module makes learning more relevant and engaging, especially for students from diverse cultural backgrounds. However, the development of ethnoscience-based e-modules faces significant challenges, such as the need to adapt the material to Indonesia's cultural diversity and the limitations of technological infrastructure in some regions. To maximize the potential of this e-module, closer cooperation is needed between material developers, educators, and local communities, as well as increased access to technology throughout Indonesia. Further research needs to focus on ways to address these challenges, as well as examine the long-term impact of ethnoscience-based e-modules on student learning outcomes, especially in areas with cultural diversity and technological limitations.

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